DRAFT

Contek Comments	Emission Source Type	Calculation Approach	Leak Detection Required (i.e. IR)	Emissions Calculated/Reported	Data Collection/Programming Requirements	Other	Emissions Equation	Contek Changes/Additions
	Pneumatic High Bleed Device Venting	mfr data & analysis (analyzer or sampling)	not required	Volumetric natural gas and CO_2/CH_4 (Volumetric and Mass) Total Mass CO_2e	Annual Minutes Vented (In operation through reporting period)	Annual average Mole % from continuous analyzer or quarterly analysis Manufacturer's bleed rate	E = B * T	$E_{s,n} = B_s * T$ (Volume of gas at std conditions) $E_{s,i} = E_{s,n} * M_i$ (Volume of CO_2 or CH_4 at std. conditions) $Mass_{s,i} = E_{s,i} * Density * GWP * 10^{-3}$ (CO_2e mass of CO_2 or CH_4)
	Pneumatic Low Bleed Device Venting	default emission factors	not required	Mass CO_2/CH_4 Total Mass CO_2e	Device Count and GHG Concentration	Emission factors provided in Tables W-1, W-3, and W-4 (Population factors)	Mass = Count * EF * GHG Conc * Conv * 24 * 365	
	Pneumatic Pump Venting	mfr data & analysis (analyzer or sampling)	not required	Volumetric natural gas and CO_2/CH_4 (Volumetric and Mass) Total Mass CO_2e	Annual Volume of Liquid Pumped (must be logged per individual pump)	Manufacturer's emission per volume of liquid (at specific operating pressure) Annual average Mole % from continuous analyzer or quarterly analysis	E = F * V	$E_{s,n} = F_s * V$ (Volume of gas at std. conditions) $E_{s,i} = E_{s,n} * M_i$ (Volume of CO_2 or CH_4 at std. conditions) $Mass_{s,i} = E_{s,i} * Density * GWP * 10^{-3}$ (CO_2e mass of CO_2 or CH_4)
	Acid Gas Removal Vents	mass balance & analysis (analyzer or sampling)		Volumetric CO_2 Total Mass CO2e	Metered Natural Gas Flow and Percent CO_2 (in/out) Ambient temperatures and pressures	Annual average Mole % from continuous analyzer or quarterly analysis	$E = (V_1 * \%Vol_1) - (V_2 * \%Vol_2)$	$E_{a,CO2} = (V_1 * \%Vol_1) - (V_2 * \%Vol_2)$ (Volume of CO_2 at ambient conditions) $E_{s,i} = (E_{a,CO2} * (460 + T_a) * P_a)/((460 + T_a) * P_s)$ (Volume of CO_2 at std. conditions) $Mass_{s,i} = E_{s,i} * Density * GWP * 10^{-3}$ (CO_2e mass of CO_2)
	Dehy Vent Stacks (without vapor recovery or thermal control)	Simulation - Glycalc		Volumetric and Mass CO_2/CH_4 Total Mass CO2e	GlyCalc			
	Well Venting for Liquids Unloading	Measurement & analysis (analyzer or sampling)		Volumetric natural gas and CO_2/CH_4 (Volumetric and Mass) Total Mass CO_2e	Annual Hours Vented and Tubing Diameter/Well-field Specific Emission Factor Ambient temperatures and pressures **OR** Well Specific Calculation Including: Casing diameter Well depth Shut-in pressure Vent Log Sales flow rate Hours of unloading	Method 1: Can use stats as long as in same field and tubing size Annual average Mole % from continuous analyzer or quarterly analysis	E = T * FR **OR** $E=[(0.37x10^{-3}) * CD^2 * WD * SP * V) + (SFR * HR)]$	**METHOD 1:** $E_{a,n} = T * FR$ (Volume of gas at ambient conditions) $E_{s,n} = (E_{a,n} * (460 + T_a) * P_a)/((460 + T_s) * P_s)$ (Volume of gas at std. conditions) $E_{s,i} = E_{s,n} * M_i$ (Volume of CO_2 or CH_4 at std. conditions) $Mass_{s,i} = E_{s,i} * Density * GWP * 10^{-3}$ (CO_2e mass of CO_2) **METHOD 2:** $E_{s,n}=[(0.37x10^{-3}) * CD^2 * WD * SP * V)] + (SFR * HR)$ (Volume of gas at standard conditions) $E_{s,i} = E_{s,n} * M_i$ (Volume of CO_2 or CH_4 at standard conditions) $Mass_{s,i} = E_{s,i} * Density * GWP * 10^{-3}$ (CO_2e mass of CO_2 or CH_4)
	Gas Well Venting for Unconventional Completions/Workovers	Measurement & analysis (analyzer or sampling)		Volumetric natural gas and CO_2/CH_4 (Volumetric and Mass) Total Mass CO_2e	Annual Hours Vented and Venting Flow Rate Ambient temperatures and pressures	Annual average Mole % from continuous analyzer or quarterly analysis	E = T * FR	$E_{a,n} = T * FR$ (Volume of gas at ambient conditions) $E_{s,n} = (E_{a,n} * (460 + T_a) * P_a)/((460 + T_s) * P_s)$ (Volume of gas at std. conditions) $E_{s,i} = E_{s,n} * M_i$ (Volume of CO_2 or CH_4 at std. conditions) $Mass_{s,i} = E_{s,i} * Density * GWP * 10^{-3}$ (CO_2e mass of CO_2)
	Gas Well Venting for Conventional Completions/Workovers	Measurement & analysis (analyzer or sampling)		Volumetric natural gas and CO_2/CH_4 (Volumetric and Mass) Total Mass CO_2e	Daily Gas Production Rate (cfm) and Annual Hours Vented Ambient temperatures and pressures	Annual average Mole % from continuous analyzer or quarterly analysis	E = V * T	$E_{a,n} = V * T$ (Volume of gas at ambient conditions) $E_{s,n} = (E_{a,n} * (460 + T_a) * P_a)/((460 + T_s) * P_s)$ (Volume of gas at std. conditions) $E_{s,i} = E_{s,n} * M_i$ (Volume of CO_2 or CH_4 at std. conditions) $Mass_{s,i} = E_{s,i} * Density * GWP * 10^{-3}$ (CO_2e mass of CO_2)
Blowdown vent stacks are not currently listed in Natural Gas Production.	~~Blowdown Vent Stacks~~	~~Calculation~~		~~Volumetric natural gas and CO_2/CH_4 (Volumetric and Mass)~~	~~Number of blowdowns per year (must be logged)~~ ~~Total Volume of Blowdown Equipment~~		~~E = N * V~~	
	Storage Tanks	Simulation - E&P Tank			E&P Tank (adjusted for vapor recovery for benficial use)			
	Well Testing Venting	Calculation & analysis (analyzer or sampling)		Volumetric natural gas and CO_2/CH_4 (Volumetric and Mass) Total Mass CO_2e	GOR BPD Flow Rate Ambient temperatures and pressures	Annual average Mole % from continuous analyzer or quarterly analysis	E = GOR * FR * D	$E_{a,n} = GOR * FR * D$ (Volume of gas at ambient conditions) $E_{s,n} = (E_{a,n} * (460 + T_s) * P_a)/((460 + T_a) * P_s)$ (Volume of gas at std. conditions) $E_{s,i} = E_{a,n} * M_i$ (Volume of CO_2 or CH_4 at std. conditions) $Mass_{s,i} = E_{s,i} * Density * GWP * 10^{-3}$ (CO_2e mass of CO_2)
	Associated Gas Venting	Calculation & analysis (analyzer or sampling)		Volumetric natural gas and CO_2/CH_4 (Volumetric and Mass) Total Mass CO_2e	GOR Barrels per Year Produced Oil Ambient temperatures and pressures	Annual average Mole % from continuous analyzer or quarterly analysis	E = GOR * V	$E_{a,n} = GOR * V$ (Volume of gas at ambient conditions) $E_{s,n} = (E_{a,n} * (460 + T_s) * P_a)/((460 + T_a) * P_s)$ (Volume of gas at std. conditions) $E_{s,i} = E_{s,n} * M_i$ (Volume of CO_2 or CH_4 at std. conditions) $Mass_{s,i} = E_{s,i} * Density * GWP * 10^{-3}$ (CO_2e mass of CO_2)

	Flare Stacks (Also used for flared emissions from dehy vent stacks, storage tanks, well testing, associated gas venting, and degassing vent vapors)	Calculation & analysis (analyzer or sampling)		Volumetric natural gas and CO_2/CH_4 (Volumetric and Mass) Total Mass CO_2e N_2O Emissions	Dependent Ambient temperatures and pressures	N_2O calculated using emission factors for gas flares, Table W-8	E (uncombust) = V * (1-η) * X E(combusted) = ∑ η * V * Y * R E(total) = E(uncombust) + E(combusted)	$E_{a,i}$ (uncombusted) = V_a * (1-η) * X_i $E_{a,CO2}$(combusted) = ∑ η * V_a * Y_i * R_i $E_{a,i}$(total) = $E_{a,i}$(uncombusted) + $E_{a,i}$(combusted) $E_{s,i}$ = ($E_{a,i}$ * (460 + T_s) * P_a)/((460 + T_a) * P_s) (Volume of GHG_i at std. conditions) $Mass_{s,i}$ = $E_{s,i}$ * Density * GWP * 10^{-3} (CO_2e mass of CO_2)
	Centrifugal Compressor Wet Seal Degassing Vents	Measurement & analysis (analyzer or sampling)	not required	Volumetric CO_2/CH_4 (Volumetric and Mass) Total Mass CO_2e	Measured Gas Flow to Vent Operational time log VRU operating log (if applicable) % used for fuel gas (if applicable)	Annual average Mole % from continuous analyzer or quarterly analysis	E = MT * T * M * (1-B)	$E_{a,i}$ = MT * T *M_i * (1 - B) $E_{s,i}$ = ($E_{a,i}$ * (460 + T_s) * P_a)/((460 + T_a) * P_s) (Volume of GHG_i at std. conditions) $Mass_{s,i}$ = $E_{s,i}$ * Density * GWP * 10^{-3} (CO_2e mass of CO_2)
	Reciprocating Compressor Rod Packing Venting	Measurement & analysis (analyzer or sampling)	~~√ - under certain circumstances~~ Uncertain about compressors for production - submitted question to EPA. Do not believe this will be	Volumetric CO_2/CH_4 (Volumetric and Mass) Total Mass CO_2e	Measured Gas Flow to Vent Operational time log OR Annual Leak Detection via Optical Monitoring *and* Measurement for Leakers	No deminimus HP Annual average Mole % from continuous analyzer or quarterly analysis	E = MT * T * M * (1-B)	$E_{a,i}$ = MT * T *M_i $E_{s,i}$ = ($E_{a,i}$ * (460 + T_s) * P_a)/((460 + T_a) * P_s) (Volume of GHG_i at std. conditions) $Mass_{s,i}$ = $E_{s,i}$ * Density * GWP * 10^{-3} (CO_2e mass of CO_2)
	Fugitives *Population emission factors - optical leak detection not required* (For streams with gas content >10%)	Measurement Analysis ???	~~√ - under certain circumstances~~	Volumetric CO_2/CH_4 (Volumetric and Mass) Total Mass CO_2e	Annual hours of operation. Emissions calculated for pneumatic low bleed device venting, gathering pipeline fugitives, coal bed methane produced water emissions and fugitive emissions from valves, connectors, open ended lines, pressure relief valves, compressor start gas vents, pumps, flanges, and	Emission factors provided in Tables W-1 through W-7 (Population factors) Concentration of GHG_i	E = Count * EF * GHG * T	$E_{s,i}$ = Count * EF *GHG_i * T (Volume of CO_2 or CH_4 at std. conditions) $Mass_{s,i}$ = $E_{s,i}$ * Density * GWP * 10^{-3} (CO_2e mass of CO_2 or CH_4)
	Hydrocarbon (HC) Liquids - Dissolved CO_2	Analysis		Total Mass CO_2e	Quarterly Sampling to Determine Retention of CO_2 in HC Liquids		Mass = S * V	$Mass_{s,CO2}$ = S_{hl} * V_{hl}
	Produced Water - Dissolved CO_2	Analysis		Total Mass CO_2e	Quarterly sampling to deterimene retention of CO_2 in produced water		Mass = S * V	$Mass_{s,CO2}$ = S_{pw} * V_{pw}
	Portable Equipment - Combustion Emissions	Measurement or Operating hours		Total Mass CO_2e	Annual Quantity of Fuel Combusted	Subpart C, Tier 1 - Default values	Subpart C, Tier 1	
	CO_2 Captured and Transferred Offsite	Measurement			Metered Quantity of CO_2 Transferred (recorded quarterly)		Subpart PP Methodology	

AXPC American Exploration & Production Council

Hand Delivery

MEMORANDUM

TO:	Administrator Cass R. Sunstein *White House Office of Information and Regulatory Affairs*
FROM:	Grover R. Campbell *Chairman, Air Subcommittee*
DATE:	September 29, 2010
RE:	EPA's Mandatory Greenhouse Gas Reporting Rule, Subpart W

The American Exploration & Production Council ("AXPC") thanks you for the opportunity to meet with you and your staff at the Office of Information and Regulatory Affairs on September 29, 2010, to discuss elements of EPA's proposed Mandatory Greenhouse Gas Reporting Rule.

Subpart W of EPA's proposed rule addresses GHG emissions from petroleum and natural gas systems.[1] AXPC is a national trade association representing 25 of the largest United States independent natural gas and crude traded corporations. AXPC members are leaders in developing and applying technology necessary to explore for and extract oil and gas onshore and offshore, including in deep water and from unconventional reservoirs. AXPC's members are among the most active in drilling natural gas and oil exploration and development wells in the United States, accounting for nearly one quarter of all wells drilled.

AXPC would like to highlight three points concerning the proposed Subpart W:

1. **Substantially the same GHG inventory accuracy can be achieved at much less cost.**

2. **A tiered system covering upstream production would be practical and effective.**

3. **Emissions from portable equipment can be exempted without impairing the inventory.**

[1] 75 Fed. Reg. 18,608 (Apr. 12, 2010).

Subpart W Imposes Disproportionate Compliance Costs with Minimal Added Accuracy.

The natural gas sector, a minor contributor to the national GHG inventory, should not be required to incur admittedly disproportionate costs to measure small-scale emissions across hundreds of thousands of individual sources.

EPA's cost estimates for proposed Subpart W are unreasonably low. AXPC and industry associations have prepared detailed analysis showing costs more than sixty (60) times EPA's estimates.[2]

Even using EPA's estimates, and even though GHG emissions from Subpart W sources are a very small part of the national GHG inventory, Subpart W sources bear a disproportionate burden – $41,000 per covered entity versus $13,000 per entity cost under the GHG Inventory Rule as a whole.

Subpart W covers only 1.4% of nationwide GHG emissions yet would apply to 500,000-750,000 sources in the natural gas sector.

Graduated Requirements Are Needed for Upstream Production Sites.

To strike the appropriate balance[3] between data accuracy and cost, the rule should use a tiered structure that avoids imposing undue costs on the smallest sources.

Exempt individual well sites with *de minimis* GHG emissions: individual well sites producing <60 MSCFD natural gas and <5 BOPD condensate, and oil stripper wells producing <10 BOPD. These sources are numerous but typically contribute less than 1,000 tpy GHGs to the national inventory.

Allow individual well sites with <3,000 tpy GHG to calculate and report emissions based on the API Compendium, rather than direct measurement. The Compendium is regularly updated and peer reviewed by government agencies and NGOs, and it aids data comparability in the sector.

Require more rigorous calculations for individual well sites with projected emissions >3,000 tpy GHG, but with much less direct measurement mandates than proposed. The direct measurement mandates drive the cost burden skywards.

---

[2] AXPC members Chesapeake Energy Corporation and El Paso Production Company individually submitted analyses to EPA on June 11, 2010 as part of the public comment process on proposed Subpart W. Chesapeake's analysis was submitted as Confidential Business Information.

[3] EPA has expressed its desire to maintain "an appropriate balance [in the GHG Inventory Rule] between data accuracy and cost." 74 Fed. Reg. 56,260, 56,280 (Oct. 30, 2009).

Emissions From Non-Stationary, Portable Equipment Should Be Exempted.

Subpart W should be made consistent with other parts of the GHG Inventory Rule that exempt portable equipment, especially given the minor emissions involved and the limited data that natural gas producers have for equipment owned and operated by third parties.

The GHG Inventory Rule does not require reporting of emissions from comparable sources, like residential, commercial or roadway construction, and Subpart C exempts portable equipment, emergency generators, and emergency equipment.

Natural gas producers generally do not control the operation of third-party equipment and do not perform or schedule maintenance.

Contract service companies typically own this equipment and control the operational data needed to calculate GHG emissions accurately.

Most portable equipment is fired by diesel fuel, and these emissions will already be reported by petroleum product suppliers under Subpart MM.

Natural Gas Star data allow a reasonable estimate of GHG emissions from this equipment. Those emissions estimates can be used with known well drilling and completion data to provide a reasonable emission estimate from these sources.

In conclusion, AXPC appreciates the opportunity to highlight for you the foregoing concerns and proposals with respect to EPA's proposed Subpart W rule. If you have any questions or would like clarification or further information, please call me at (405) 935-7543.

Appendix A
to Comments Filed by
Chesapeake Energy Corporation
Regarding EPA's Proposed Rule for Mandatory Reporting
of Greenhouse Gases: Petroleum and Natural Gas Systems;
75 Fed. Reg. 18,608 (Apr. 12, 2010)[1]

Agreed. ok to post on web.

[1] Appendix A contains Confidential Business Information and is being submitted separately from the rest of Chesapeake Energy Corporation's comments on Proposed Subpart W to the Mandatory Greenhouse Gas Reporting Rule, 75 Fed. Reg. 18,608 (Apr. 12, 2010), Docket ID No. EPA-HQ-OAR-2009-0923.

Appendix A: MRR Subpart W Compliance Cost Estimate

Submitted by: Chesapeake Energy Corporation

Prepared By:
Zack Schaffer
Asset Manager – Gas Star Program

Docket ID No. EPA-HQ-OAR-2009-0923
June 11, 2010

CONFIDENTIAL BUSINESS INFORMATION

Prepared By:
Zack Schaffer
Asset Manager – Gas Star Program

MRR Subpart W Compliance Cost Estimate

The re-proposed Subpart W of the Mandatory Greenhouse Gas Reporting Rule requires onshore producers of oil and natural gas to report fugitive and vented emissions if those emissions are greater than or equal to 25,000 tonnes of CO_2 equivalent within a basin. EPA's estimate of first-year compliance costs for onshore producers is $24,000 per reporting unit. *See* Table W-10, 75 Fed. Reg. at 18,629 (Apr. 12, 2010). Chesapeake Energy Corporation's ("Chesapeake's") operations and environmental, health and safety staff developed a bottom-up compliance cost estimate to demonstrate the actual costs to the natural gas industry.

As proposed, Subpart W would require reporting of 21 individual fugitive and venting emissions sources. The scope of this cost estimate covers many of those sources, but is focused mainly on sources commonly found in Chesapeake's actual operations.

Compliance Cost Estimate

Chesapeake selected one basin from the AAPG Geologic Provinces Code Map as an example basin. Several sites within that basin were visited to survey the reportable sources and the level of effort required to comply with proposed Subpart W. The representative basin that Chesapeake selected houses a large portion of Chesapeake's Midcontinent operations. With over 8,000 wells within the basin, it is apparent that Chesapeake will cross the 25,000 tonne threshold and would be required report emissions under proposed Subpart W. While Chesapeake acknowledges that the actual compliance costs within a given basin can range greatly depending on the equipment operated and levels of activity, Table 1 below details the estimated compliance cost for an individual reporting unit assuming all operations are subject to reporting.

Table 1: Estimated Compliance Costs for Chesapeake's First Year of Operations

	Chesapeake's Operations in a Representative Basin		
	Estimate of Sources	Cost per Source	Compliance Cost Estimate
Single-Well Pads	5,174	$1,495	$7,735,450
Single-Well Pads w/no oil tank	2,990	$350	$1,046,425
Multi-Well Pads	50	$2,705	$135,250
Dehydrators	382	$288	$109,825
Recips	368	$805	$296,240
Completions	198	$4,050	$801,900
Workovers	66	$4,050	$268,920
Workovers w/no frac and flowback	598	$100	$59,760
Overhead	1	$2,583	$2,583
Total			**$10,456,353**

To develop the compliance cost estimate, the text of proposed Subpart W was reviewed with particular focus on 40 C.F.R. § 98.233: Calculating GHG Emissions and 40 C.F.R. § 98.236: Data Reporting Requirements. These sections of the proposed regulations detail the levels of aggregation required to calculate and report emissions. While emissions would be aggregated and reported at the basin level under the proposed text of Subpart W, certain data would need to be collected at individual well sites and even at individual pieces of equipment. After reviewing the calculations and reporting requirements, the following sources were developed as the base units for collecting data:

- Single-well Pads (with and without oil tanks)
- Multi-well Pads
- Glycol Dehydrators
- Reciprocating Compressors
- Completion Operations
- Workover Operations

At each of these base units, different data points would need to be collected for reporting purposes under the proposed Subpart W.

Chesapeake's estimate of compliance costs was developed using estimates of labor rates, level of effort, and equipment rental costs based on discussion with various Chesapeake operations and EHS staff.

Description of Source Categories

Single-Well Pads

A single-well pad contains one oil or gas producing well with production equipment that may include separators and heater treaters, hydrocarbon liquids and water storage tanks, as well as piping, controls, and instrumentation to manage gas and liquid flows. Large equipment such as compressors, dehydrators, or acid gas removal units may be present on-site, but for the purposes of this analysis those pieces of equipment have been treated separately. Several single-well pads were visited and reviewed prior to developing the compliance cost estimates.

Compliance Cost Estimate: **$1,495 per single-well pad**
$350 per single-well pad w/no oil tank

Chesapeake ENERGY

Multi-Well Pads

A multi-well pad is a location where single-well facilities share one contiguous pad. These sites share the same equipment as single-well pads but contain a greater amount of equipment. On average, for Chesapeake's operations, a multi-well pad contains 2-3 wellheads.

Compliance Cost Estimate: **$2,705 per multi-well pad**

Glycol Dehydrators

A glycol dehydrator is used to remove water from sales or fuel gas streams. Glycol dehydrators can be installed at single or multi-well pad sites but have been treated separately for this compliance cost estimate. The time and effort required for data collection and reporting is incremental to the efforts described for the single or multi-well facility in which the dehydrator is installed.

Compliance Cost Estimate: **$288 per dehydrator**

Reciprocating Compressors

Reciprocating compressors are used for a number of functions in Chesapeake's operations including gas lift, wellhead compression, and gathering compression. Reciprocating compressors can be installed at single or multi-well pad sites but have been treated separately for this compliance cost estimate. The time and effort required for data collection and reporting is incremental to the efforts described for the single or multi-well facility in which the compressor is installed.

Compliance Cost Estimate: **$805 per reciprocating compressor**

Completion Operations

During flowback in completion operations gas is sometimes vented to the atmosphere. Proposed Subpart W would require the direct measurement of gas flowrate during the completion in each operating field every other year.

Compliance Cost Estimate: **$4,050 per completion**

Workover Operations

Workovers are performed for a number of reasons, including re-completing, clean-up, modifying or replacing tubing, installing artificial lift equipment, etc. Proposed Subpart W would require reporting gas vented during workover operations, but there is not a clear distinction between a conventional and an unconventional workover.

Compliance Cost Estimate: **$100-4,050 per workover**

Chesapeake ENERGY

Overhead, Quality Control, and Reporting Costs

To perform the proposed calculations on the data collected in the field and produce reports for EPA, Chesapeake would incur overhead costs to develop the IT systems and reports. Chesapeake is ahead of most of the industry in terms of sophisticated data gathering and reporting mechanisms, but the overhead costs associated with reporting under Subpart W are not insignificant.

Compliance Cost Estimate: **$50,000 Chesapeake-wide IT costs**
$500 per basin report

If you have any questions concerning Chesapeake's comments or require clarification, please contact me at (405) 935-7543.

Thank you for your consideration,

Grover R. Campbell
Chesapeake Energy Corporation
Manager – Corp. Air Regulations